



**ECHO Services –  
Foundational middleware for  
a Science Cyberinfrastructure**

**WGISS – March  
2005**

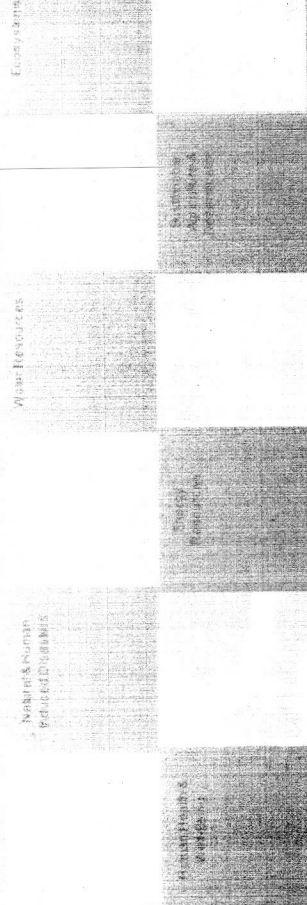
# Goals of the presentation

- View of the future
- ECHO Overview
- Approach to Registries
- Interoperability
- Current status & activities



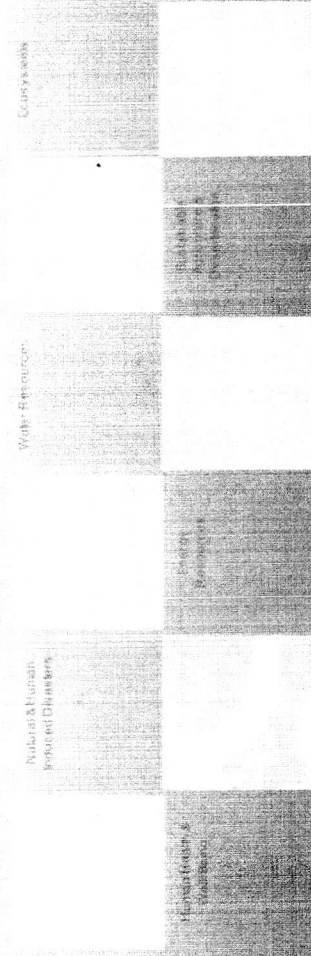
## Supporting a comprehensive, and coordinated environment

- For science, education, governments, industry
- For system development and contribution
- Organic resource utilization
  - Resource capacity is established throughout the partner community
  - Partners offer what they wish
- Enabling Science that is...
  - Comprehensive
  - Coordinated
  - Sustained

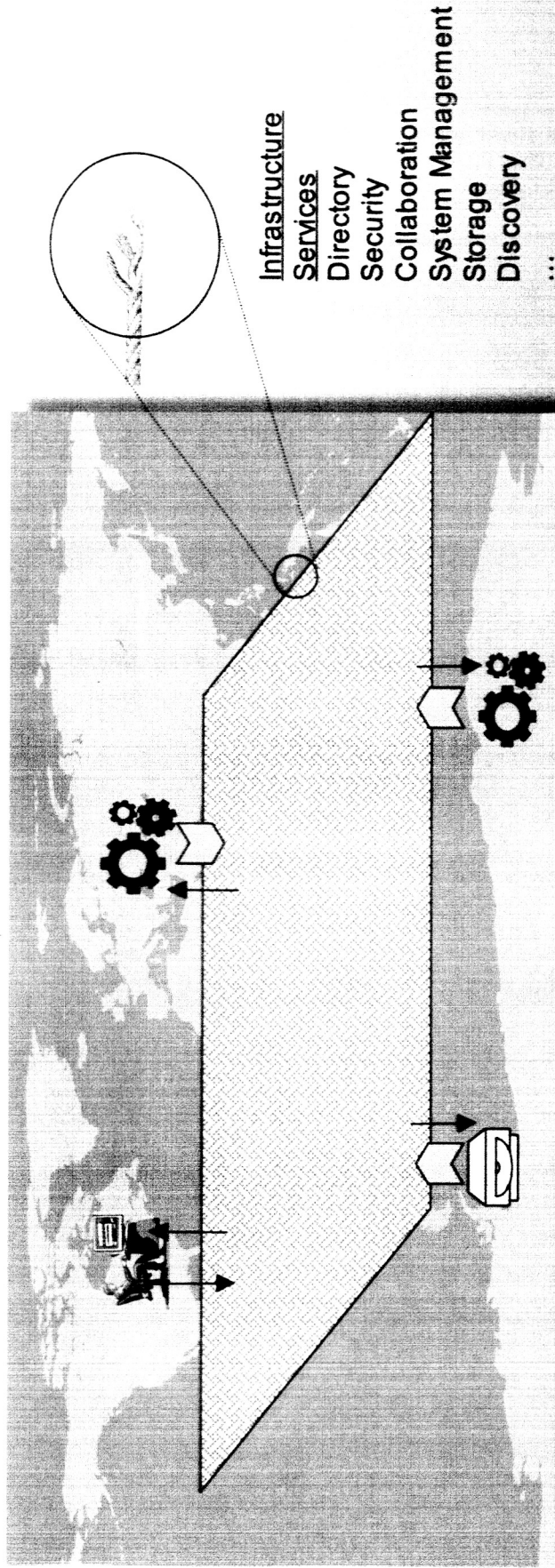


# New paradigm

- **Service-oriented enterprise**
- **Net-centric computing**
  - Power to the participants – producers and consumers
  - Enable with infrastructure of service middleware
- **GEOSS momentum**



# Cyberinfrastructure - Underlying Fabric



# ECHO Vision

- **Goals**
  - Support a Marketplace ...
  - Enabling ...
- **Approach**
  - Interoperable Registries
  - Not “the” solution/system
    - But integrated into a dynamic enterprise
    - Building systems, interoperating with systems
  - Net-centric
    - Power to the partners



# ECHO IS...

- **Interoperability middleware solution -**
  - Open, XML-based APIs
  - Supporting net-centric architectures and solutions
  - Set of interoperable registries for both data (metadata) and services
  - Provides user accounts and common infrastructure for the registries
  - Built upon a layered architecture with extensible infrastructure for supporting community unique protocols
  - Operational since November 2002
  - Available as open source

## Data Registry

*Representing data resources through metadata*

- **Publish Capability**
  - Supports Collection, Granules and Browse publication
  - Product Specific Attributes extending the standard data model
- **Discovery Capability**
  - Collection/Dataset
  - Granule/Inventory
  - Based on Z39.50 Standard
  - Full results Management
- **Access Capability**
  - Online Access
  - Legacy Order Mechanisms
  - Access Controls
    - Visibility of data resources
    - Access to data resources

## **Metadata Subscriptions**

## Service Registry

*Service offerings leveraging Web Service Standards*

### **Publish Capability**

- Advertisements
- Service Interfaces
- Service Implementations
- Service GUIs
- Linkage to Data Registry

### **Discovery Capability**

- UDDI Standard Based
- Data Registry View (*What services are appropriate for this collection/granules?*)

### **Future**

- Service Brokering
- Access Controls



# Power in the hands of the community

- **Data and Service Partners**

- Use ECHO's Partner Interface tools to manage how their resources are represented in the registries
- 2-level access control in Data Registry (metadata visibility, ordering)
- In defining each dataset, partners can establish which spatial search mechanism (Cartesian, geodetic, orbital) is best suited for searching that dataset
- Special data modules supported as needed. (ie. Orbital search module)
- Extending the standard data model through product specific metadata

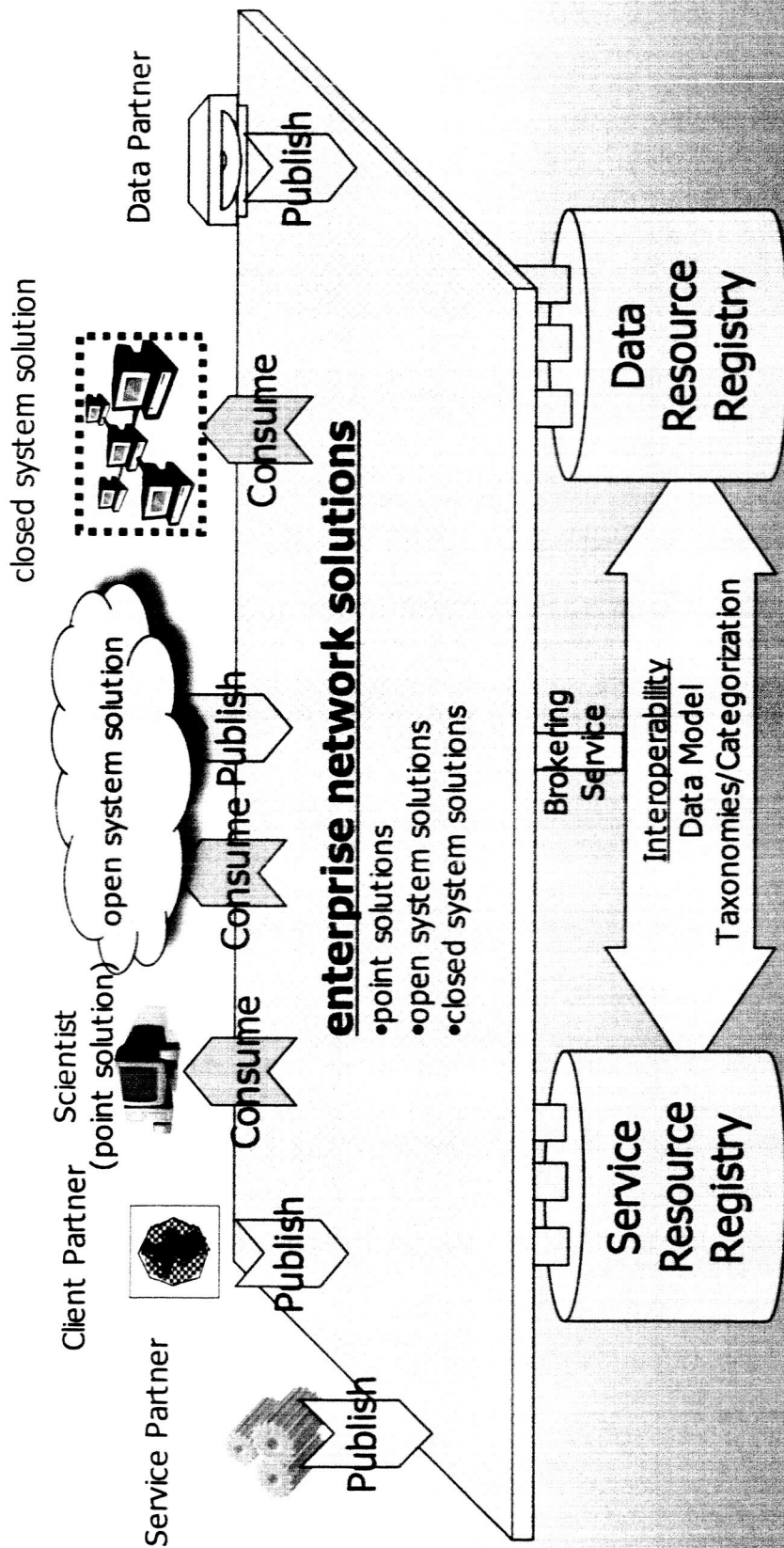
- **Client Partners**

- Provide discipline specific, application specific or individual preferred views of the contents of the clearinghouse
- Use ECHO's APIs to access the clearinghouse to convey a seamless, efficient view of data holdings

- **Service Partners**

- Advertise their service offerings
  - General Advertisements, Service Interfaces (API specifications), Service Instances (web services) or GUIs
- Classification of services through taxonomies
- Service offerings describe in WSDL
- Access to services through SOAP

# Registries in the Enterprise



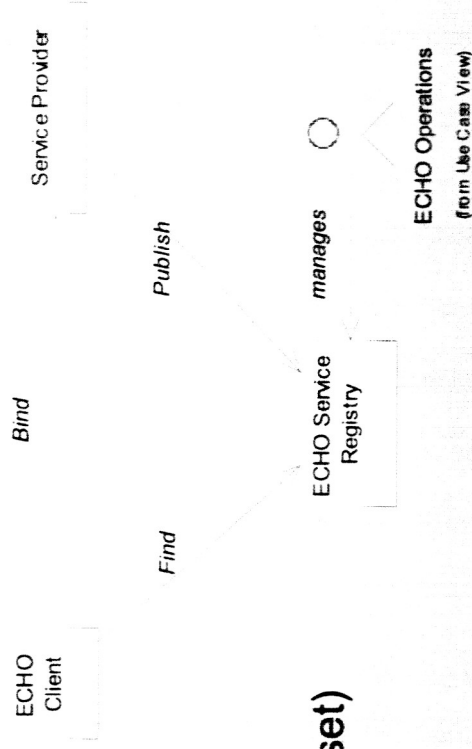
# ECHO Service Registry

- **Supporting SOA**

- Publish
- Find
- Bind

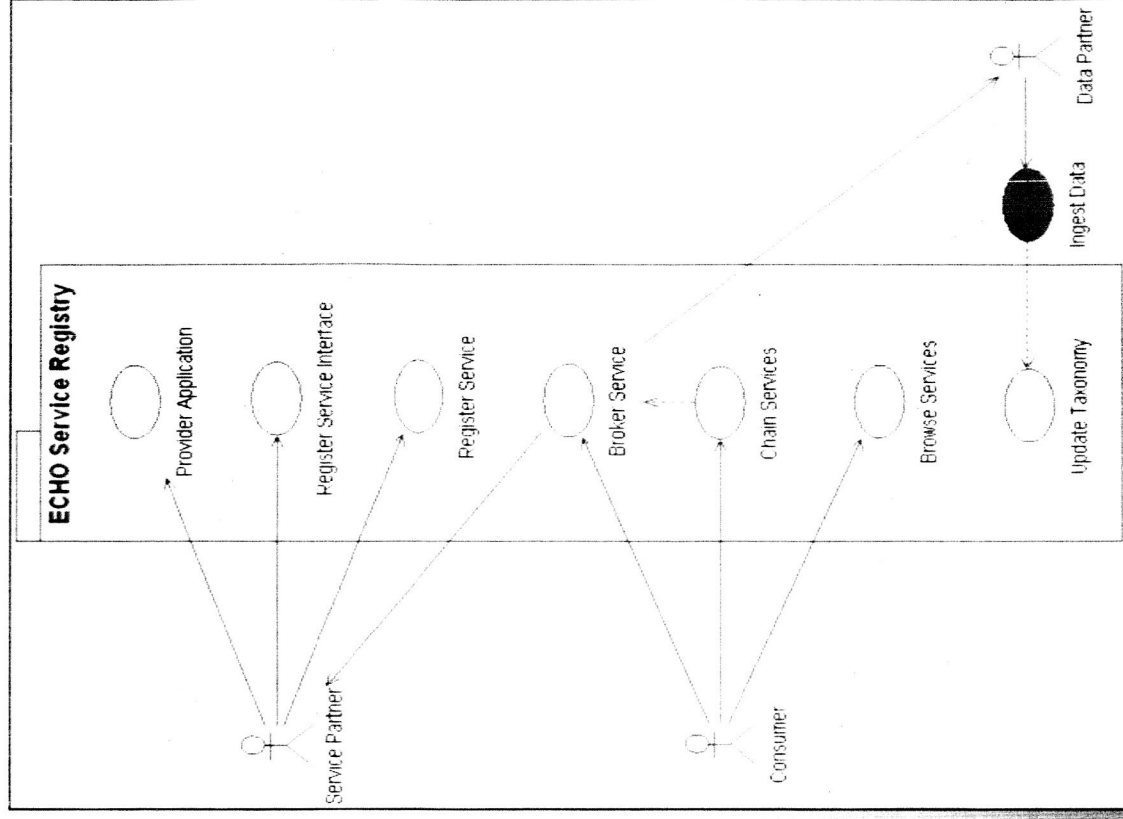
- **Using Web Service Strategy**

- Service Description
  - WSDL (Interface & Implementation)
  - Parameter language (ECHO/ISO 19115 subset)
- Service Binding
  - SOAP
  - WxS Issues
- Registry
  - UDDI



# Fundamental Use Cases

- Publishing
- Discovering
- Understanding
- Accessing





# Publish

Resource Partners "advertise" their offerings to publicly available registries

## Data Registry

- Public Interface: "IngestService"
  - Register, Ingest services
- Standards
  - Data Dictionary ISO 11179 based
  - Data Model based on EOS
  - ISO 19115 Compliant
  - GCMD mapping
  - FGDC mapping
- Technology - Oracle database

## Service Registry

- Public Interface: "ExtendedServicesManagement"
  - Register service
- Standards
  - Service Description – WSDL
  - Registry – UDDI
  - OGC Service Taxonomy (ISO 19119)
- Technology – Systinet WASP UDDI Server

## Issues

### Data Model inconsistency

- Ingest adapters for data model translation and validation

### Data Fidelity

- Update and delete interfaces available
- Time delays between registry and source

# Discovery

Consumers participate in the marketplace by looking for resources of interest

## Data Registry

- Public Interface: "CatalogService"
  - Query
- Inventory and Dataset level
- Standards
  - Z30.50 based queries and results management
- Technology – XML-based API
  - Oracle augmented with additional spatial query engine

## Service Registry

- Public Interface:
  - UDDI: Inquiry
  - Registry (domain)
- Standards
  - UDDI
- Technology – Systinet WASP UDDI Server

## Issues

### Interoperability

- Data represented in a consistent data model
- Service – Data Interoperability through Taxonomies
- Common Data Language for data definition and parameter specification

# Brokering

*Active Interoperability by facilitating the invocation of services upon data resources from different sources*

## Brokering Service

- Public Interface: "BrokerService"
  - Validate, Submit
- Optimize data access pattern, bind to service on behalf of consumer, manage status and results delivery
- Standards
  - TCP/IP based data access and delivery
- Technology – XML-based API

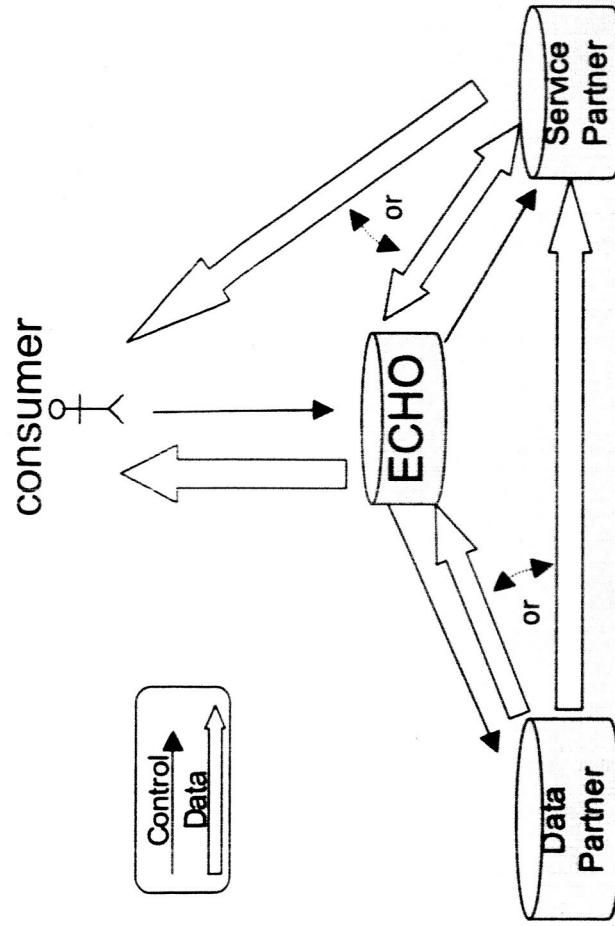
## Issues

- Interoperability – Matching services to data
- Common Data Language for data definition and parameter specification
  - Validation operation (optional)
  - Co-location
    - Moving data, not services (so far)
    - Temporary resources provided for facilitating data movement

- Resource Efficiency
- Validation operation (optional)
  - Security
    - Registered Users only
    - Moving data, not services

# Basic Brokering Pattern

*Multiple paths for data movement in support of  
brokering or orchestrating services*



Brokering Service optimizes

data movement from path based on:

- Data partner access options
- Service Partner access and delivery options
- Consumer requests



# Orchestration

*Customers orchestrate the active integration of multiple resources in a sequence*

## Orchestration Service

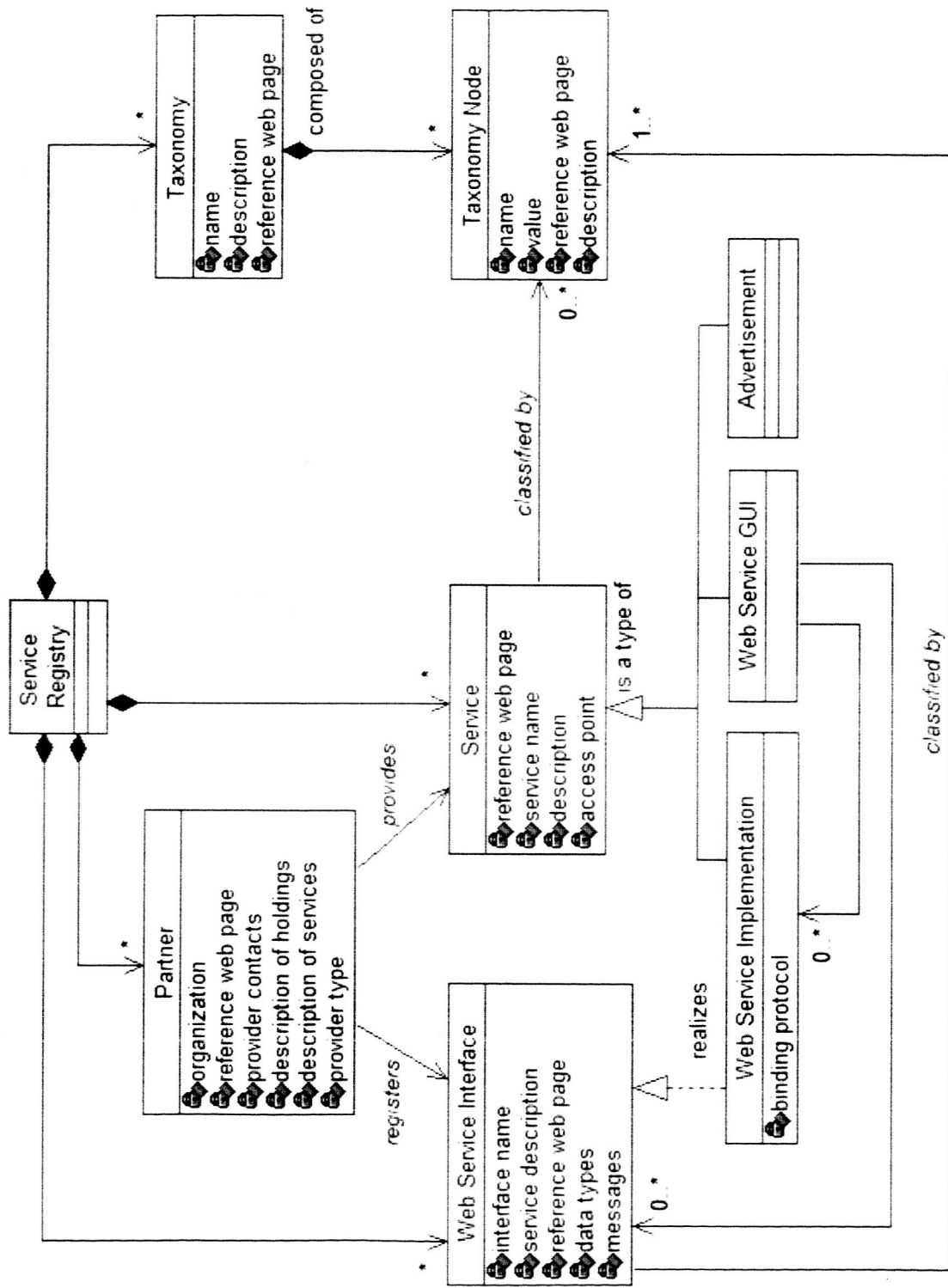
- Public Interface: "Orchestrate"
  - Validate, Submit
- Ensure service invocation sequence is valid
- Translucent and Aggregate/Opaque capabilities
- Standards
  - OCG efforts (OWS 2.0) ISO 19119
- Technology – XML-based API

## Issues

Interoperability –

- Data represented in a consistent data model
- Service – data interoperability through taxonomies
- Common data language for data definition and service parameter specification

# Service model



# Interoperability

- **Between registries**
  - Service Registry through Taxonomies
  - Data Registry through Catalog Service
    - <details>
- **External Interoperability**
  - Adaptors
    - Protocol interoperability with Partners for order and ingest
    - Data model interoperability through Ingest Adapters and data set registration
    - Can establish “Views” of results
  - API's enable external other interoperability through adaptors
    - Ostensibly, ECHO clients

# Classification

- **Taxonomies (so far)**

- Data Set
  - Data Partner → Dataset → Version
- Data Format
  - Similar to mime-type
- Service Type
  - OCG/OSE model
  - Looking for others

- **Other Classification schemes possible**

- **Potential for user defined taxonomies**

- Dynamically defined and leveraged
- Profile entities
- Semantic web integration



# Service Semantic understanding

- **Ensure that services can work together**
  - Enabling binding is easy for a registry
  - Flexibility always has its price
    - Understanding relevance of context and parameters in an open, dynamic and loosely coupled network enterprise is the challenge
  - Developing a Common Data Language for parameter specification

- **Service Metadata**

- Common way of describing
  - Partner
  - Service Type
  - Interface
  - Source
  - Capability
  - Understanding
  - Applicability

# UDDI v3

- Upcoming Technology evolution
- Key Features
  - Multi-registry environments
    - Allows for federation of service registries
  - Publisher specified keys
    - Beyond UUIDs
    - Flexible and powerful namespace management
  - Security enhancements
    - Adds digital signing to core data types

# Rules of Engagement for Service Partners

- **Register**
- **Provide Reference Web Page**
- **Active Services**
  - Provide WSDL
  - SOAP binding point
- **Optionally:**
  - Categorize resource
- **Brokered**
  - Declare Input access support
  - Declare Output support

# Current Data Partner Status

## 5 Operational:

|                                                                                  |                                                     | Collections | Granules   | Browse    |
|----------------------------------------------------------------------------------|-----------------------------------------------------|-------------|------------|-----------|
| Oak Ridge National Laboratory (ORNL)<br>Distributed Active Archive Center (DAAC) | Department of Energy, ORNL, Oak Ridge,<br>Tennessee | 679         | 105,706    | 0         |
| Land Processes EOS Core System (ECS)<br>DAAC                                     | USGS Eros Data Center, Sioux Falls, SD              | 87          | 11,587,961 | 2,349,125 |
| Goddard ECS DAAC                                                                 | NASA/GSFC, Greenbelt, MD                            | 357         | 18,071,296 | 1,890,246 |
| Socioeconomic Data and Applications<br>Center (SEDAC)                            | Columbia University, New York, NY                   | 50          | 0          | 0         |
| Alaska SAR Facility                                                              | University of Alaska, Fairbanks, AK                 | 14          | 1,872,361  | 0         |

## 3 Development/Test:

|                                                   |                                    | Collections | Granules  | Browse    |
|---------------------------------------------------|------------------------------------|-------------|-----------|-----------|
| National Snow and Ice Data Center (NSIDC)<br>DAAC | University of Colorado, Boulder CO | 35          | 62,066    | 0         |
| Atmospheric Sciences Data Center (ASDC)<br>DAAC   | NASA/LaRC, Hampton, VA             | 93          | 2,954,549 | 1,507,711 |
| Stennis Space Center Data Purchase Project        | NASA/SSC, Stennis Space Center, MS | 22          | 17,766    | 15,892    |



# Current Client Partner Status

## 2 Operational:

|                                     |                                                                                             |
|-------------------------------------|---------------------------------------------------------------------------------------------|
| Mercury EOS                         | Oak Ridge National Laboratory (ORNL) DAAC, Department of Energy, ORNL, Oak Ridge, Tennessee |
| Power User Interface (script based) | Earth Science Data and Information System (ESDIS) Project, NASA/GSFC, Greenbelt, MD         |

## 9 Development/Test:

|                                        |                                                    |
|----------------------------------------|----------------------------------------------------|
| ASF ECHO Client                        | University of Alaska, Fairbanks, AK                |
| Data Validation User Interface (DVUI)  | ESDIS Project, NASA/GSFC, Greenbelt, MD            |
| MODIS Website                          | MODIS Project, NASA/GSFC, Greenbelt MD             |
| SNOWI-E                                | NSIDC, University of Colorado, Boulder, CO         |
| WISRD                                  | NSIDC, University of Colorado, Boulder, CO         |
| WIST (Warehouse Inventory Search Tool) | ESDIS Project, NASA/GSFC, Greenbelt, MD            |
| New Earth Observer (NEO)               | Earth Science Directorate, NASA/GSFC, Greenbelt MD |
| Simple MODIS ECHO Client (SIMECC)      | MODIS Rapidfire Project, NASA/GSFC, Greenbelt MD   |
| Invasive Species                       | NASA and USGS                                      |

## **Current Activities**

- **Brokering Services**
- **Service Orchestration – exploration within the ESIP community**

# **ESIP Participation**

- **Strategic Direction**
  - Promote Services that can participate in SOA systems
  - Descriptions in WSDL
  - SOAP access/interface
- **Establish a testbed of a service registry**
  - Using ECHO
  - Semi-public
- **Explore techniques and technologies of orchestration**